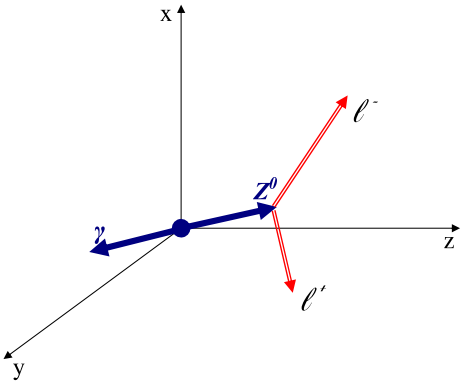

Figure 1: Zγ di-boson production with Z decay into two leptons in the center of mass of Zγ

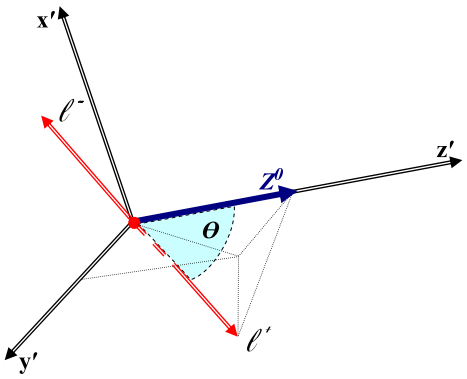

Figure 2: Decay helicity angle (θ) in the rest frame of Z boson

1 Helicity Angle Distribution

Distribution of the helicity angles is an important characteristic of the particle interactions, especially in the EWK sector of high energy physics. The proper modeling of the helicity distributions is significant for MC generators. Study of the generated helicity angle distributions in comparison with reconstructed distributions is essential for acceptance calculations. Helicity angles provide additional information about anomalous couplings and contribute to the sensitivity of searches for new physics.

Four MC generators have been studied (Baur, Sherpa, Madgraph, Pythia) for Z standard model di-boson production for pp collisions at 7 TeV center of mass energy, with Z decaying into two electrons or muons. Helicity angle we study is the decay angle of the Z boson (θ) - angle between the direction of the Z boson and the direction of the positive lepton in the rest frame of the Z boson (Figure 2). The distribution of the $\cos\theta$ should yield a quadratic distribution, because of the spin 1 of the Z boson. Results (Figure 3) demonstrate that each of the generators has implemented helicity angle distributions. The comparison between them(Figure 4) shows that angular distributions are modeled in a fairly similar way.

The acceptance of the detector simulation with the requirements for the reconstruction of leptons and photon in the di-boson production will result in distortion of the generated distribution of $\cos\theta$. Low energy leptons are more unlikely to pass all the requirement cuts. In terms of the $\cos\theta$, we can say that positive lepton with $\cos\theta \simeq -1$ will most likely fail the cuts, so will the negative lepton with $\cos\theta \simeq 1$. The comparison plots of the generated and reconstructed distributions show this behavior (Figure 6).

Existing LHC data comparison plot with Baur MC shows that generated distribution is in agreement with the data.

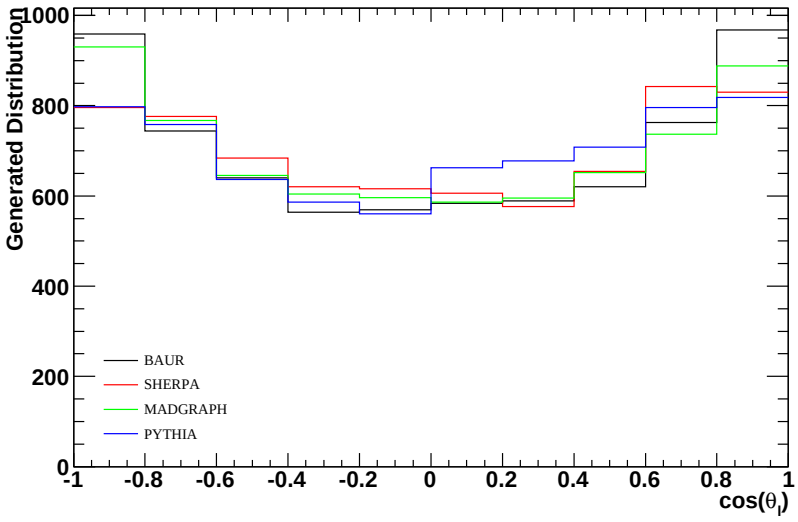

Figure 3: Generated helicity angle distribution

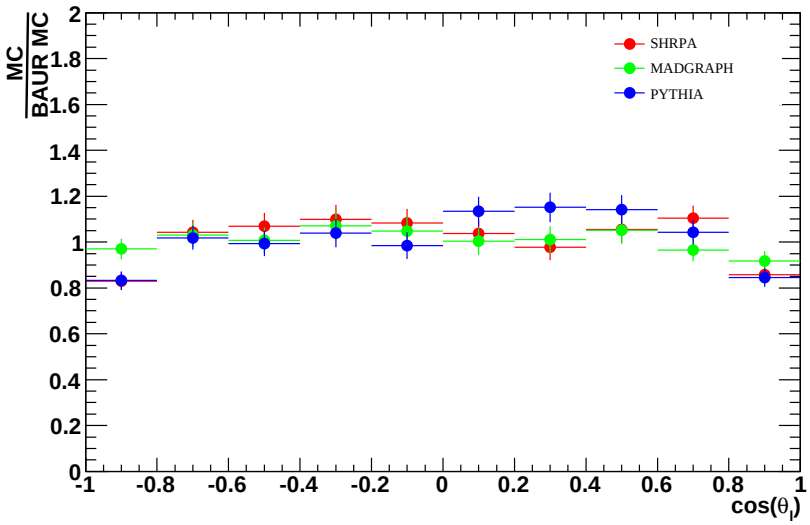

Figure 4: Generated helicity angle distribution ratio to Baur generated distribution

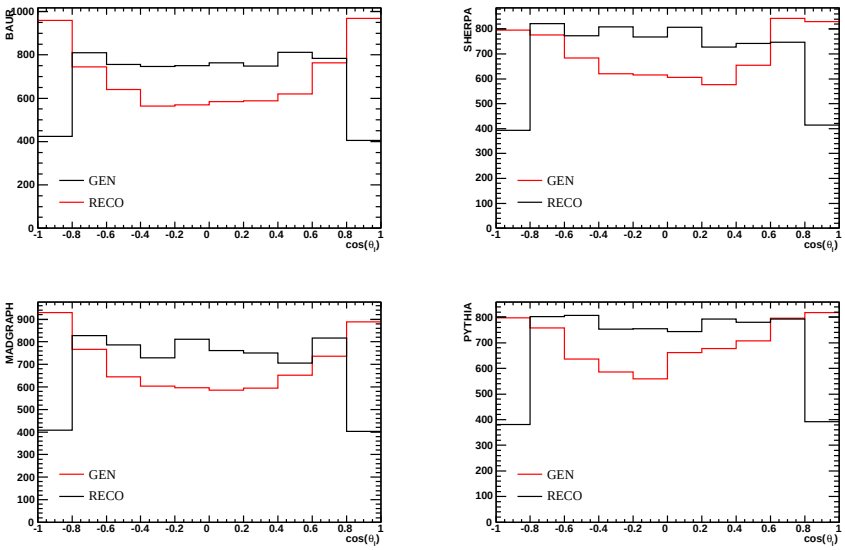

Figure 5: Comparison of generated and reconstructed helicity angle distribution

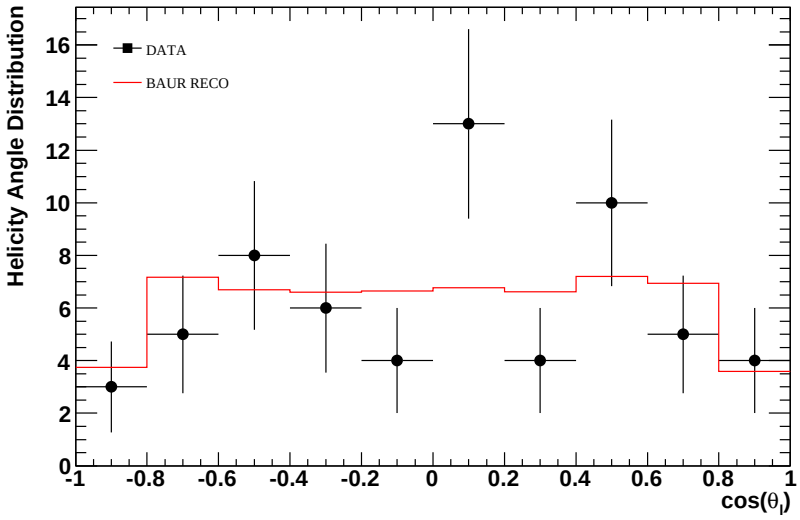

Figure 6: Baur MC comparision to LHC data